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William D. Walton and Nora H. Jason, Editors

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COVER

U.S. Coast Guard and Minerals Management Service sponsored fire-resistant oil spill containment boom performance test using a non-commercial test boom at the Coast Guard Fire and Safety Test Detachment, Mobile, AL, August 1997. William D. Walton, Photographer.

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PREPAREDNESS FOR *IN SITU* BURNING OPERATIONS: AN ALASKAN PERSPECTIVE

Bruce McKenzie
Alaska Clean Seas
Prudhoe Bay, Alaska

James Lukin
Lukin Publications Management
Anchorage, Alaska

SUMMARY

Response organizations and contingency plan holders have spent millions of dollars in the last 10 years preparing for the use of *in situ* burning for spill response. Efforts have included research and development, extensive training, and the acquisition of fire-resistant booms and ignition systems. Unfortunately, despite this work, the probability that responders will actually be able to use *in situ* burning on a spill remains very small. The reasons include the public perception that burning is bad, a regulatory bias against *in situ* burning, and a general lack of comfort on the part of decision makers. Response organizations and contingency plan holders should not be expected to maintain an *in situ* burn capability if the chances of using it are extremely low and if they do not get credit for the capability in their contingency plans. This paper discusses the hurdles that need to be overcome to make *in situ* burning truly a primary response option.

HISTORICAL PERSPECTIVE

Alaska Clean Seas[1] and S.L. Ross[2] provide summaries of documented cases in which *in situ* burning has been used on actual spills. Since 1958 there have been only 21 such cases. These burns occurred in North America and in Europe and do not include events involving accidental ignition (i.e., tankers, blowouts, or production facilities). It is important to note that 10 of the 21 burns occurred in ice conditions where mechanical containment and recovery operations were hampered.

The number of documented cases of *in situ* burning is considered conservative. In the former Soviet Union, *in situ* burning has been, and continues to be, used as a preferred response technique. This preference appears to be driven by remoteness considerations, prevalence of ice conditions, lack of logistical infrastructure to mount a mechanical response, and the relative low cost of *in situ* burning compared to mechanical options[3].

Kucklick and Aurand[4] reviewed marine *in situ* burning opportunities in the United States between 1973 and 1991. They collected information on marine spills of 1,000 barrels or larger in the coastal and offshore waters of the United States (excluding Alaska). Each incident was examined against specific criteria to determine whether or not a spill could have been a candidate for *in situ* burning.

Criteria included an API gravity of less than 45, wind speeds of less than 19 kn, and a distance of at least 4.8 km (3 mi) from a sensitive receptor. Their review showed that on average there were two crude oil and two refined oil spills in the United States each year on which *in situ* burning might have been considered for use. Over the period reviewed, 45% of the crude oil spills and 25% of refined oil spills greater than 1,000 barrels were potential candidates for burning. When the criteria were modified (i.e., the distance from a receptor was decreased from 4.8 km [3 mi] to 0.4 km [0.25 mi]), the number of oil spills on which burning could have been considered nearly doubled. It should be noted that 99% of the spills in the United States between 1973 and 1991 were less than 1,000 barrels. Kucklick and Aurand used a l,000 barrel criterion because of data gaps on spills of lesser volumes. The authors note that the number of spills that were identified as candidates for *in situ* burning is probably low.

In the State of Alaska, *in situ* burning has been used as a response technique only twice since 1989. A test burn was conducted on the *Exxon Valdez* oil spill[5]; and in 1992, turbine fuel from a tank truck rollover in a mountain pass was successfully ignited. For Alaskan North Slope operations from 1989 to 1997, there have been 306 crude oil spills and 435 refined product spills, for a total of 741 spills. None of these spills was greater than 1,000 barrels.

Generally, it can be concluded that *in situ* burning has not been widely used as a spill response technique. Instances of use tend to involve spills in ice conditions where mechanical containment and recovery operations have been hampered or are ineffective.

REQUIRED CONDITIONS FOR BURNING

A number of physical limitations restrict the feasibility of *in situ* burning. These include wind speed, wave height, thickness of the oil, oil type, degree of weathering, and oil emulsification. The following are general rules of thumb for conducting *in situ* burning:

- Winds less than 20 kt (37 km/hr or 23 mi/hr).
- For on-water spills, waves of less than 62 cm to 92 cm (2 ft to 3 ft).
- A minimum thickness of 2 mm to 3 mm (0.08 in to 0.12 in) for fresh crude oil and thicker for diesel or weathered crude.
- For most crude oils, less than 30% evaporative loss.
- For oil-in-water emulsions, a water content of less than 25%.

In situ burning must be conducted in a defined window of opportunity--a fact clearly demonstrated during the *Exxon Valdez* spill in 1989[5].

PUBLIC PERCEPTION

Over the last 10 years, industry and government have attempted to rigorously characterize the health and environmental impacts of *in situ* burning and to refine the operational methodologies and tools for burning[6,7]. This effort has included development of public education tools to simplify the discussion of a complex and often emotional topic. For example, in 1995, the Alaska Department of Environmental Conservation (ADEC) and Alaska Clean Seas (ACS) jointly produced a public education pamphlet and video on the advantages, disadvantages, and environmental trade-offs of *in situ* burning[8].

Despite this effort, many public interest groups remain skeptical. In response to the 1998 draft environmental impact statement for the proposed offshore development of Northstar in the Beaufort Sea[9], Greenpeace raised several concerns about the practicability of *in situ* burning operations and about air pollution generated from the burning of an oil spill[10].

On the other hand, the Cook Inlet Regional Citizens' Advisory Council (Cook Inlet RCAC) has been a strong proponent of *in situ* burning as a primary spill response technique in Cook Inlet during the winter months. Upper Cook Inlet is typically covered with broken ice from mid-November to mid-April. The Cook Inlet RCAC recognizes the limited applicability of mechanical containment and recovery operations in broken ice conditions[11].

ACCEPTANCE OF *IN SITU* BURNING BY FACILITY MANAGERS

In a spill event involving an oil terminal, exploration well, pipeline, production facility or refinery, the Incident Commander position will most likely be filled by the facility manager. In general, facility managers tend to be reluctant to endorse *in situ* burning as a spill response tool[12]. In the course of normal duties, facility managers are responsible for the safety of their staff and facility. In any petroleum industry activity, great efforts are taken to minimize the risk of fire or explosion. There are numerous reminders of the consequences of unwanted fires in the petroleum industry.

Some justification may exist for this bias against *in situ* burning among facility managers. As an example, the methodology commonly described for extinguishing a burn on water is to speed up the tow and cause boom failure, allowing the oil to spread into a thin layer that will no longer support combustion. No successful use of this technique has been documented. Conversely, a crude oil burn was successfully conducted immediately adjacent to an aboveground portion of the trans-Alaska pipeline in 1978. This burn had no impact on operations or the integrity of the pipeline.

RESPONDER PREPAREDNESS

ACS is considered one of the leaders in the field of *in situ* burning. Since the early 1980s, ACS has conducted *in situ* burning research and development. ACS has funded and conducted a variety of projects including the NOBE (Newfoundland Offshore Burn Experiment) burn, the use of the heli-torch as an ignition device, and the burning of highly emulsified crude oils[13,14]. The value of the inventory of *in situ* burning equipment maintained by ACS exceeds $4.4 million--primarily in fire-resistant boom and aerial ignition systems. In addition, ACS maintains an active training program relating to *in situ* burning.

Both Cook Inlet Spill Prevention and Response, Inc. (CISPRI) and the Ship Escort/Response Vessel System (SERVS), the two other major Alaskan oil spill response organizations, also have been active participants in *in situ* burning research and development, and maintain significant burning capabilities. This includes fire-resistant boom and ignition systems, regular training, and pre-identified strategies for conducting burns. Interestingly, to maintain proficiency in heli-torch operations, CISPRI has worked with the local officials who use heli-torches in the control of forest fires.

THE REGULATORY ENVIRONMENT

According to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) of the United States, the federal on-scene coordinator must obtain approval from the regional response team (RRT) for the use of *in situ* burning. Under the NCP, RRTs are required to address, as appropriate, such use through pre-authorization plans and agreements among the federal and state agencies. The Alaska Regional Response Team (ARRT) developed the *In Situ* Burning Guidelines for Alaska[15] in 1994. The guidelines state that burning will be considered as a possible response option only when mechanical containment and recovery response methods are incapable of controlling the spill. Additionally, in response to potential public health concerns, the ARRT established a safe downwind distance of 9.6 km (6 mi) from human populations as the primary decision criterion for conducting burning operations. This distance was based on modeling of the distance downwind at which atmospheric conditions will disperse particulate emissions of PM10 from an *in situ* burn to a concentration below 150 micrograms per cubic meter ($\mu g/m^3$). The ARRT adopted the U.S. Environmental Protection Agency's (EPA) 24-hour PM10 standard (150 $\mu g/m^3$). Based on guidance provided by the National Response Team (NRT), the averaging time was reduced from 24 hours to a one-hour average exposure limit.

The ARRT guidelines are presently under revision. According to the latest draft[16], federal and state on-scene coordinators will still consider burning only when mechanical containment and recovery are infeasible or incapable of controlling the oil spill. Based on the EPA's recently established particulate matter standard for PM2.5, the draft ARRT guidelines state that the safe distance separating human populations from *in situ* burns is the downwind radius for the fire at which PM2.5 concentrations at the ground diminish to 65 $\mu g/m^3$ averaged over 1 hour. Based on modeling, this is estimated to be at the 4.8 km (3 mi) range.

State regulations also can hamper decisions to use *in situ* burning. For example, the State of Alaska Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75.430 - 440) require contingency plan holders to demonstrate on paper the ability to "contain or control and cleanup within 72 hours that portion of the response planning standard that enters open water." In 18 AAC 75.445(g)(l), plan holders are required to meet established response planning standards using mechanical containment and recovery methods. The regulations state that the response planning standards are means by which the adequacy of an oil spill plan can be judged by the Alaska Department of Environmental Conservation and that these standards do not constitute cleanup standards that must be met by the plan holder. This subtle differentiation is not readily understood by the general public. Contingency plans in Alaska have established a false expectation that cleanup of worst-case discharges can be achieved in 72 hours using mechanical containment and recovery operations. This becomes particularly problematic in ice environments, where the efficiency of mechanical containment and recovery operations is dramatically reduced as ice concentrations increase. This bias for mechanical containment and recovery is reinforced in the ARRT *In Situ* Burning Guidelines for Alaska[15].

THE CASE FOR *IN SITU* BURNING

As described above, *in situ* burning has not been used extensively as a response tool in the United States. Based on a skeptical public attitude, a regulatory bias for mechanical response, and the reticence of oil industry facility managers to allow burning in and around their facilities, one must question the utility of maintaining an *in situ* burning capability. Oil spill response cooperatives and industry have no incentive to continue to fund *in situ* burning research or maintain preparedness when there is little likelihood that the use of burning will be approved. We must not forget that the purchase and maintenance of spill response equipment and capability are costly. While this expense can be seen as a cost of doing business, great pressure exists in the oil industry to minimize expenses that cut into the bottom line--especially during times, like now, of low oil prices.

The arguments in favor of burning spilled oil are familiar to us all and are quite compelling mechanical removal is often limited; burning can prevent the spread of oil to shore, where most damage is done; burning eliminates many of the toxic volatiles that evaporate from an oil slick; burning protects wildlife from the physical effects of oiling; the human health risks are manageable and are related mainly to soot, and much of the spilled oil was originally destined to be turned into carbon dioxide anyway.

The fact that regional response teams have been tasked with developing guidelines for the use of burning indicates that some policymakers understand its value as a response tool. Why is it, then, that local RRTs and states make approval to burn an actual spill contingent on demonstrating that the use of mechanical techniques is impossible? We also know that to be effective, burning must start as soon as possible after the spill when the oil is most easily ignitable and before the oil begins to spread. In Alaska, response can be hampered by great distances, severe weather, lack of logistical infrastructure, and the presence of ice for several months of the year.

What is apparent is that many fail to recognize that in some cases, burning may be the only viable response option left to responders. Recently, the Alaska Department of Environmental Conservation, in a review of industry spill response capability in broken ice, suggested that the oil industry on the North Slope should acquire millions of dollars worth of barges and skimming equipment in an effort to marginally increase the ability to mechanically remove oil in broken ice[17]. This position is probably understandable, given the regulatory bias against burning, but does it make sense for the environment--and also for the industry--when the period of concern on the North Slope lasts for only a few weeks?

Under many conditions, particularly broken ice on water, *in situ* burning is the safest and most effective means to respond to a spill. In fact, one can easily argue that for such conditions, burning is the best available technology since it will potentially remove from the water far more oil than mechanical containment and recovery. Until regulators, facility operators, and the public are made to understand these facts, it is hard for spill response planners to recommend expenditures on equipment and training for a response technique that never will be used.

RECOMMENDED ACTIONS

- At the national level, there needs to be recognition of the potentially valuable role that *in situ* burning can play in spill response. For vessel response plans, federal regulations (33 CFR 154 and 155) call for an increase in the amount of mechanical recovery equipment that is required to be ensured, by contract or other approved means, in 1998 and 2003. Prior to implementing the so-called "cap" increases, the U.S. Coast Guard is required to conduct a review to determine if any proposed increases are practicable. The Coast Guard is considering including mandatory dispersant requirements in the 1998 scheduled cap increase. For those areas of the United States where dispersant may not be practicable on a year-round basis, a similar initiative should be considered for *in situ* burning.

- The Alaska state government needs to recognize that ice conditions are a fact of life over most of Alaska for several months of the year. State oil spill regulations were designed as a reaction to a batch release of oil in Prince William Sound (*Exxon Valdez*), where ice does not form in winter. They do not adequately address the conditions that exist throughout the rest of the state, particularly in the Beaufort Sea. The regulations should be revised to reflect the reality of response in ice-infested waters.

- Industry must educate and demonstrate to facility managers that *in situ* burning can be conducted safely in close proximity to their facilities.

- Responders, both in industry and the regulatory community, must continue to educate the public on the importance of *in situ* burning and its net environmental benefit.

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